VERIFICATION OF TRANSLATION

I, Manabu Kawamoto

of MIYOSHI & MIYOSHI, Toranomon Daiichi Building, 2-3, Toranomon 1-chome, Minato-ku, Tokyo, Japan,

do hereby declare that I have a thorough knowledge of the Japanese and English languages and that the writing contained in the following pages is a correct translation of the attached Japanese Patent Office Certificate bearing the file reference

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I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-captioned application or any patent issuing therefrom.

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M. Kawamoto

Manabu Kawamoto

[Name of Document] SPECIFICATION

[Title of the Invention] FUEL CELL SYSTEM

[Claim for a Patent]

[Claim 1] A fuel cell system, comprising:

a fuel cell supplied with an air and fuel to generate an electric power;

an air adjusting unit located in a main air-flow passage led to the fuel cell;

a bypass flow passage provided in parallel with the main flow passage; and

a flow passage change-over means for setting the air-flow passage to the fuel cell to a side of the bypass flow passage until a predefined condition is established after commencement of a start-up operation.

[Claim 2] A fuel cell system according to claim 1, wherein the bypass flow passage has an inner diameter of a duct line smaller than that of the main flow passage.

[Claim 3] A fuel cell system according to claim 1 or 2, further comprising:

a compressor for supplying the air to the fuel cell;

a motor for driving the compressor;

a start-up battery for supplying an electric power to the motor during the start-up operation; and

a power supply change-over device allowing the power source to the meter to be changed over from the start-up battery to the fuel cell at a point of time when it is determined that the fuel cell has reached an operating state to generate the sufficient electric power.

[Claim 4] A fuel cell system according to any one of claims 1 to 3, wherein the air adjusting unit includes a heat exchanger.

[Claim 5] A fuel cell system according to any one of claims 1 to 4, wherein the air adjusting unit includes a silencer.

[Claim 6] A fuel cell system according to any one of claims 1 to 5, wherein the flow passage change-over means executes a change-over of the air-flow passage to the fuel cell in response to a flow rate of air supplied to the fuel cell.

[Claim 7] A fuel cell system according to claim 6, further comprising an air flow meter for measuring the flow rate of the air, located downstream of a junction where the main flow passage and the bypass flow passage merge.

[Claim 8] A fuel cell system according to any one of claims 1 to 7, wherein the flow passage change-over means executes a change-over of the air-flow passage to the fuel cell in response to a pressure of the air supplied to the fuel cell.

[Claim 9] A fuel cell system according to claim 8, further comprising a pressure gauge for measuring the pressure of the air, located downstream of a junction where the main flow passage and the bypass flow passage merge.

[Claim 10] A fuel cell system according to any one of claims 1 to 9, wherein the flow passage change-over means executes a change-over of the air-flow passage to the fuel cell in response to a temperature of the air supplied to the fuel cell.

[Claim 11] A fuel cell system according to claim 10, further comprising a temperature sensor for measuring the temperature of the air, located downstream of a junction where the main flow passage and the bypass flow passage merge.

[Claim 12] A fuel cell system according to any one of claims 1 to 11, further comprising a filter located downstream of a

junction where the main flow passage and the bypass flow passage merge.

[Claim 13] A fuel cell system according to any one of claims 1 to 12, further comprising a humidity controller located downstream of a junction where the main flow passage and the bypass flow passage merge.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a fuel cell system.

[0002]

[Prior Art]

In a fuel cell system, a fuel gas (hydrogen gas) is supplied to a fuel electrode of a fuel cell and an air is supplied to an oxidation electrode, with the fuel gas and air electrochemically reacting with one another to generate an electric power.

[0003]

As a structure of an air supply system in such the fuel cell system, for example, the structure as shown in Fig. 6 is general. In this fuel cell system, a compressed air derived from a compressor 2 is supplied to a fuel cell 1 through a silencer 10 provided on an air flow passage downstream of the compressor 2 and a heat exchanger 11. Here, since most of compressors 2 are generally of capacity type and a discharge pulsating noise occurs, the silencer 10 is provided in order

to reduce this. Further, the heat exchanger 11 is provided so as to adjust a temperature of the compressed air to a temperature that the fuel cell 1 does not cause failure.

[0004]

A motor 15 for driving the compressor 2 is operated by a selective power supply from a start-up battery 18 or the fuel cell 1 by a power supply change-over device 17. At the time of commencement of the fuel cell system, the motor 15 is started by a power supply from the start-up battery 18. When the fuel cell 1 generates an electric power enough to drive the motor 15, the power supply to the motor 15 is changed over to the fuel cell 1. After that, a part of the electric power generated by the fuel cell 1 is utilized for driving the motor 15.

[0005]

[Problems to be Solved by the Invention]

However, in such the fuel cell system, as compressed air adjusting devices such as the silencer 10 and the heat exchanger 11 are provided in an air flow passage from the compressor 2 to the fuel cell 1, a capacity of these devices causes a time delay in supplying a pressure and a flow rate of an air. For this reason, at the time of commencement of the fuel cell system, the air of a sufficient amount and pressure is not supplied to the fuel cell 1, and a time period until the fuel cell 1 starts generating an electric power is prolonged. Accordingly, in order to drive the motor 1 during this long start-up operation, the start-up battery 18 is set to have a large battery capacity or the start-up battery 18 is formed as a large-sized and high-priced secondary battery. This required countermeasure led to high cost.

[0006]

Further, when the fuel cell system is started in a cold state, a temperature of the compressed air is reduced by the compressed air adjusting device having a large heat capacity, and a power generation efficiency of the fuel cell 1 is lowered to degrade a start-up performance. For this reason, as a load of the start-up battery 18 increases, after all, such countermeasure was necessary that the battery capacity of the start-up battery 18 is increased or the large-sized and high-priced secondary battery is used.

[0007]

The present invention has been invented in view of such the problems, and it is an object of the present invention to provide a fuel cell system in which an air is promptly supplied to a fuel cell at the time of a start-up operation to expedite a rise of the fuel cell and a start-up battery is made small.

[0008]

[Means for Solving the Problems]

According to a first aspect of the present invention, the fuel cell system comprises: a fuel cell supplied with an air and fuel to generate an electric power; an air adjusting unit located in a main air-flow passage led to the fuel cell; a bypass flow passage provided in parallel with the main flow passage; and a flow passage change-over means for setting the air-flow passage to the fuel cell to a side of the bypass flow passage until a predefined condition is established after commencement of a start-up operation.

[0009]

According to a second aspect of the present invention,

the bypass flow passage has an inner diameter of a duct line smaller than that of the main flow passage.

[0010]

According to a third aspect of the present invention, the fuel cell system further comprises: a compressor for supplying the air to the fuel cell; a motor for driving the compressor; a start-up battery for supplying an electric power to the motor during the start-up operation; and a power supply change-over device allowing the power source to the meter to be changed over from the start-up battery to the fuel cell at a point of time when it is determined that the fuel cell has reached an operating state to generate the sufficient electric power.

[0011]

According to a fourth aspect of the present invention, the air adjusting unit includes a heat exchanger.

[0012]

According to a fifth aspect of the present invention, the air adjusting unit includes a silencer.

[0013]

According to a sixth aspect of the present invention, the flow passage change-over means executes a change-over of the air-flow passage to the fuel cell in response to a flow rate of air supplied to the fuel cell.

[0014]

According to a seventh aspect of the present invention, the fuel cell system further comprises an air flow meter for

measuring the flow rate of the air, located downstream of a junction where the main flow passage and the bypass flow passage merge.

[0015]

According to an eighth aspect of the present invention, the flow passage change-over means executes a change-over of the air-flow passage to the fuel cell in response to a pressure of the air supplied to the fuel cell.

[0016]

According to a ninth aspect of the present invention, the fuel cell system further comprises a pressure gauge for measuring the pressure of the air, located downstream of a junction where the main flow passage and the bypass flow passage merge.

[0017]

According to a tenth aspect of the present invention, the flow passage change-over means executes a change-over of the air-flow passage to the fuel cell in response to a temperature of the air supplied to the fuel cell.

[0018]

According to an eleventh aspect of the present invention, a temperature sensor for measuring the temperature of the air is located downstream of a junction where the main flow passage and the bypass flow passage merge.

[0019]

According to a twelfth aspect of the present invention,

a filter is located downstream of a junction where the main flow passage and the bypass flow passage merge.

[0020]

According to a thirteenth aspect of the present invention, a humidity controller is located downstream of a junction where the main flow passage and the bypass flow passage merge.

[0021]

[Action and Effect of the Invention]

According to the first aspect of the present invention, at the time of the start-up operation of the fuel cell system, the air flow passage is on a side of the bypass flow passage until a predetermined condition is established. As a result, as an air to the fuel cell is supplied detouring the air adjusting unit, a time delay caused by a capacity of the air adjusting unit does not occur in the air flow rate or pressure. Accordingly, a necessary air is promptly supplied to the fuel cell at the time of the start-up operation, and a start-up performance of the fuel cell can be raised. Further, in starting at the time of the cold state, as the air passes the air adjusting unit having a large heat capacity to decrease a temperature thereof, it is possible to prevent a reduction in an efficiency of an electric power generation of the fuel cell and to increase the start-up performance of the fuel cell.

[0022]

According to the second aspect of the present invention, as the inner diameter of the duct line of the bypass flow passage is smaller than the main flow passage, a pressure in the duct line can easily be increased in accordance with a component which reduces the capacity of the duct line. The pressure of

the air supplied to the fuel cell can promptly be raised and the start-up performance of the fuel cell can be increased.

[0023]

According to the third aspect of the present invention, the motor for driving the compressor receives a power supply from the start-up battery at the time of the start-up operation of the fuel cell system, but the air passes the bypass flow passage to be supplied to the fuel cell at the time of the start-up operation. As a result, the fuel cell rises at an early stage to generate a sufficient electric power. For this reason, as the power supply from the start-up battery to the fuel cell can be changed over at an early stage and a power consumption of the start-up battery may be small, the start-up battery can be small-sized and low-priced to curtail the cost.

[0024]

According to the fourth aspect of the present invention, as the heat exchanger is provided as the air adjusting unit, the air of a relatively low temperature is supplied to the fuel cell through the bypass flow passage at the time of the start-up operation, and an early rise of the fuel cell is attained. On the other hand, when the temperature of the air was high after completion of the start-up operation, the air flow passage is changed over to the main flow passage side and the air is adjusted to a temperature that the fuel cell does not cause failure by the heat exchanger, before being supplied. Accordingly, the rational air supply to the fuel cell is possible from the start-up operation to the regular operation.

[0025]

According to the fifth aspect of the present invention, as the silencer is provided as the air adjusting unit, when noise

is relatively small at the time of the start-up operation, the air is supplied to the fuel cell through the bypass flow passage, and an early rise of the fuel cell is attained. On the other hand, when the noise is large after completion of the start-up operation, the air flow passage is changed over to the main flow passage side, and the noise is silenced by the silencer. Accordingly, the noise generated with the air supply to the fuel cell can be prevented rationally.

[0026]

According to the sixth aspect of the present invention, as the air flow passage is changed over in response to the air flow rate to the fuel cell, the change-over of the air flow passage can be accurately controlled in accordance with a supply state of the air to the fuel cell.

[0027]

According to the seventh aspect of the present invention, as the air flow meter is arranged downstream of the junction where the main flow passage and the bypass flow passage merge, the air flow rate can be measured at a site close to the fuel cell, and the air flow rate supplied to the fuel cell can be accurately grasped. Therefore, the flow passage change-over can be accurately controlled in response to this flow rate.

[0028]

According to the eighth aspect of the present invention, as the air flow passage is changed over in response to the air pressure to the fuel cell, the change-over of the air flow passage can be accurately controlled in accordance with a supply state of the air to the fuel cell.

[0029]

According to the ninth aspect of the present invention, as the pressure gauge is arranged downstream of the junction where the main flow passage and the bypass flow passage merge, the air pressure can be measured at a site close to the fuel cell, and the air pressure supplied to the fuel cell can be accurately grasped. Therefore, the flow passage change-over can be accurately controlled in response to this pressure.

[0030]

According to the tenth aspect of the present invention, as the air flow passage is changed over in response to the air temperature to the fuel cell, the change-over of the air flow passage can be accurately controlled in accordance with a supply state of the air to the fuel cell. In particular, in starting of the cold state, as the flow passage is changed over when the air temperature to the fuel cell is appropriately increased, a timing of the flow passage change-over can be determined appropriately.

[0031]

According to the eleventh aspect of the present invention, as the pressure gauge is arranged downstream of the junction where the main flow passage and the bypass flow passage merge, the air pressure can be measured at a site close to the fuel cell, and the air pressure supplied to the fuel cell can be accurately grasped. Therefore, the flow passage change-over can be accurately controlled in response to this pressure.

[0032]

According to the twelfth aspect of the present invention, as the filter is arranged downstream of the junction where the main flow passage and the bypass flow passage merge, even when

the compressed air passes the bypass flow passage at the time of the start-up operation, a harmful dust can be eliminated from the air and the efficiency of the electric power generation of the fuel cell can be increased.

[0033]

According to the thirteenth aspect of the present invention, as the humidity controller is arranged downstream of the junction where the main flow passage and the bypass flow passage merge, even when the compressed air passes the bypass flow passage at the time of the start-up operation, the humidity of the air can be adjusted to the appropriate humidity for the electric power generation in the fuel cell, and the efficiency of the electric power generation of the fuel cell can be increased.

[0034]

[Preferred Embodiments]

Hereinafter, embodiments of the present invention will be explained with reference to the accompanying drawings.

[0035]

Fig. 1 is a block diagram showing a fuel cell system according to a first embodiment of the present invention. It is to be noted that this block diagram shows only a configuration of an oxidizing agent (compressed air) supply related system to a fuel cell as a feature portion of the present invention, and a configuration of a fuel gas (hydrogen gas) supply related system to the fuel cell is omitted.

[0036]

As shown in Fig. 1, this fuel cell system comprises a fuel cell 1 which is supplied with the compressed air and the hydrogen gas to generate an electric power, and a compressor 2 for feeding the compressed air to an oxidizing agent electrode (cathode electrode) of this fuel cell 1.

[0037]

An air cleaner 3 and a flow rate meter 4 are provided upstream of the compressor 2. An air sucked from a duct 5 is cleaned by the air cleaner 3 and is introduced into the compressor 2. An air flow rate which is introduced into the compressor 2 and is supplied to a side of the fuel cell 1 is measured by the flow rate meter 4.

[0038]

A flow passage from the compressor 2 to the downstream fuel cell 1 is partially branched to a main flow passage 6 and a bypass flow passage 7 which are provided in parallel with each other. A change-over valve 8 is provided at a branch point between the main flow passage 6 and the bypass flow passage 7 and a change-over valve 9 is provided at a confluence, respectively. By changing over these change-over valves 8 and 9, the compressed air from the compressor 2 selectively passes either one of the main flow passage 6 and the bypass flow passage 7 and reaches the fuel cell 1.

[0039]

In the main flow passage 6, a silencer 10 and a heat exchanger 11 are interposed as a compressed air adjusting unit. The silencer 10 is a device for reducing a discharge pulsating noise from the compressor 2 in which a capacity type is mainly used. Further, the heat exchanger 11 is a device for reducing a temperature of the compressed air down to a temperature that

the fuel cell 1 is not damaged.

[0040]

The bypass flow passage 7 is constituted by a duct line having a smaller inner diameter than the main flow passage 6, and the compressed air adjusting unit such as the silencer 10 and the compressor 12 is not provided on the bypass flow passage 7. Thus, when the compressed air from the compressor 2 is introduced to a side of the bypass flow passage 7, a time delay does not occur at a flow rate and a pressure level of the compressed air based on a capacity of the compressed air adjusting unit, and further as the capacity to increase the pressure level may be small in response to a fine piping. Therefore, even at the time of starting of the fuel cell system, a sufficient amount of air can quickly be supplied to the fuel cell 1. It is to be noted that a diameter of the duct line of the bypass flow passage 7 is fined in the range of adversely affecting a pressure loss when the flow passage is changed over by the change-over valves 8 and 9.

[0041]

A pressure gauge 12 is provided between the change-over valve 9 and the fuel cell 1. A pressure level of the compressed air to be introduced into the fuel cell 1 is measured by this pressure gauge 12.

[0042]

An original material gas (hydrogen gas) fed from a supply mechanism (not shown) of a fuel gas is adjusted to a pressure level in conformity to a compressed air pressure level by a pressure adjusting valve 13, and then is supplied to a fuel electrode (anode electrode) of the fuel cell 1. The compressed air and the hydrogen gas are consumed for the electric power

generation in the fuel cell 1. It is to be noted that a surplus air which has not been consumed for the electric power generation is released to the atmosphere through a pressure adjusting valve 14.

[0043]

An electric power is supplied to a motor 15 for driving the compressor 2 through an inverter 16 for controlling an engine speed of the motor 15 and a power supply change-over device 17. The power supply change-over device 17 is a device for selectively changing over a power supply to be supplied from a start-up battery 18 (e.g., 12V battery) through a booster 19 and a power supply to be supplied from the fuel cell 1. The start-up battery 18 is a power supply to be used for starting of the compressor 2 at the time of starting of the fuel cell system, and while an amount of electric power generation of the fuel cell 1 is insufficient for driving the motor 15, the power supply from the start-up battery 18 is supplied. If the amount of electric power generation of the fuel cell 1 increases up to a level of covering a power consumption of the compressor 2 and various auxiliary engines thereof, the power supply change-over device 17 changes over the power supply to the fuel cell 1.

[0044]

A controller 20 is a device for controlling an operation of the fuel cell system. Specifically, a detection signal from the flow rate meter 4 and the pressure gauge 12 is input thereto and also the controller 20 is electrically connected to the change-over valve 8, the change-over valve 9, the pressure gauge 12, the pressure adjusting valve 13, the pressure adjusting valve 14, the inverter 16, and the power supply change-over device 17, to control these operations.

[0045]

Fig. 2 is a flow chart showing a process procedure of a control at the time of starting in association with a supply of the compressed air to be executed in the controller 20. This control is executed immediately after commencement of a start-up operation of the fuel cell system.

[0046]

In step S1, the change-over valves 8 and 9 are changed over so that a flow passage from the compressor 2 is connected to the bypass flow passage 7. In step S2, the power supply from the start-up battery 18 is supplied to the motor 15 to accelerate the motor 15 aiming at a predetermined target engine speed.

[0047]

In step S3, an air flow rate Q measured by the flow rate meter 4 and an air pressure level P measured by the pressure gauge 12 are compared with a power supply change-over flow rate threshold value Q1 and a power supply change-over pressure threshold value P1, respectively, and it is determined whether or not the air flow rate Q is equal to or more than the power supply change-over flow rate threshold value Q1 and the air pressure level P is equal to or more than the power supply change-over pressure threshold value P1. Here, the power supply change-over flow rate threshold value Q1 and the power supply change-over pressure threshold value P1 are reference values for determining that the amount of electric power generation of the fuel cell 1 rises up to a level capable of driving the motor 15 and various auxiliary engines, and an appropriate value has in advance been set as the reference value.

[0048]

From this determination, when at least one of the air flow rate Q and the air pressure level P does not exceed the power supply change-over flow rate threshold value Q1 and the power supply change-over pressure threshold value P1, this means that the fuel cell 1 does not rise up to a status capable of driving the motor 15 or the like. Therefore, the process returns to step S2, to further accelerate the motor 15.

[0049]

On the other hand, when the air flow rate Q exceeds the power supply change-over flow rate threshold value Q1 and the air pressure level P exceeds the power supply change-over pressure threshold value P1, this means that the fuel cell 1 rose up to a status capable of driving the motor 15 or the like. Therefore, the process proceeds to step S4, to change over the power supply to the motor 15 to the fuel cell 1.

[0050]

It is to be noted that in the first embodiment, two factors of the air flow rate Q and the air pressure level P are used for determining the change-over of the power supply, and when both the air flow rate Q and the air pressure level P exceed the power supply change-over flow rate threshold value Q1 and the power supply change-over pressure threshold value P1, respectively, the power supply is changed over. However, the present invention is not limited to such form. For example, only either one of the air flow rate Q and the air pressure level P may be used for determining the change-over of the power supply, or both of the air flow rate Q and the air pressure level P may be used for determining the change-over of the power supply, and simultaneously when either one of the air flow rate Q and the air pressure level P exceeds the power supply change-over flow rate threshold value Q1 and the power supply change-over

pressure threshold value P1, the power supply may be changed over. In this manner, an amount of measurement for use in determining a power supply change-over timing can be occasionally selected, or can occasionally be used by combination.

[0051]

In step S5, the motor 15 is accelerated toward the target engine speed by supplying the power supply from the fuel cell 1.

[0052]

In step S6, the air flow rate Q and the air pressure level P are compared with a flow passage change-over flow rate threshold value Q2 and a flow passage change-over pressure threshold value P2, respectively, and it is determined whether or not the air flow rate Q is equal to or more than the flow passage change-over flow rate threshold value Q2 and the air pressure level P is equal to or more than the flow passage change-over pressure threshold value P2. Here, the flow passage change-over flow rate threshold value Q2 and the flow passage change-over pressure threshold value P2 are reference values for determining whether or not the flow rate and pressure level of the compressed air from the compressor 2 are increased up to a level of not arising the problem even if the air flows in the main flow passage 6 side, and appropriate values which are respectively greater than the power supply change-over flow rate threshold value Q1 and the power supply change-over pressure threshold value P1 have in advance been set as the reference values.

[0053]

From this determination, when at least one of the air flow

rate and the air pressure level does not exceed the flow passage change-over flow rate threshold value Q2 and the flow passage change-over pressure threshold value P2, this means that the air flow rate and the pressure has not yet increased sufficiently. Therefore, the process returns to step S5, to further accelerate the motor 15.

[0054]

On the other hand, when the air flow rate exceeds the flow passage change-over flow rate threshold value Q2 and the air pressure level exceeds the flow passage change-over pressure threshold value P2, this means that the air flow rate and pressure from the compressor 2 are increased up to a level of not arising the problem even if the air flows in the main flow passage 6 side. Therefore, the process advances to step S7, and the change-over valves 8 and 9 are changed over to set the flow passage from the compressor 2 to the main flow passage 6 side.

[0055]

It is to be noted that in this determination of the flow passage change-over, when both of the air flow rate Q and the air pressure P exceed the flow passage change-over flow rate threshold value Q2 and the flow passage change-over pressure threshold value P2, respectively, the power supply is changed over. However, similarly to the case of determining the power supply change-over, the present invention is not limited to such form. For example, only either one of the air flow rate Q and the air pressure P may be used for determining the flow passage change-over, or both of the air flow rate Q and the air pressure P may be used for determining the flow passage change-over, and simultaneously when either one of the air flow rate Q and the air pressure P exceed the flow passage change-over flow rate threshold value Q2 and the flow passage change-over pressure

threshold value P2, the power supply may be changed over. In this manner, the measurement amount for determining the flow passage change-over timing can be appropriately selected and further can appropriately be used by combination.

[0056]

By the process of step S7, a routine of controlling at the time of starting is terminated and the fuel cell system is transferred to a regular operation. In the regular operation, the compressed air from the compressor 2 is supplied to the fuel cell 1 through the main flow passage 6 to generate an electric power by the fuel cell 1.

[0057]

Next, the overall function and effect will be described.

[0058]

When the fuel cell system is started, the motor 15 is supplied with the power supply from the start-up battery 18, and the compressor 2 is driven by the motor 15 to start discharging the air to the fuel cell 1 side. The engine speed of the motor 15 is accelerated toward a predetermined target engine speed.

[0059]

Upon commencement of the start-up operation, the air flow passage from the compressor 2 is changed over to the bypass flow passage 7 side by the change-over valves 8 and 9. Thus, the compressed air from the compressor 2 detours various air adjusting units (the silencer 10 and the heat exchanger 11) on the main flow passage 6 side, passes the bypass flow passage 7 and is supplied to the fuel cell 1 side.

[0060]

As described above, at the time of commencement of the fuel cell system, as the compressed air passes the bypass flow passage 7 which does not include the air adjusting unit and is supplied to the fuel cell 1, a time delay in the flow rate and pressure of the compressed air does not occur based on the capacity included in the compressed air adjusting unit such as the silencer 10 and the heat exchanger 11. Further, as the duct line of the bypass flow passage 7 is finer than the main flow passage 6 keeping within the limits that the pressure loss does not occur at the time of change-over, it is not necessary that the surplus pressure within the duct line is raised. Accordingly, the sufficient amount of compressed air is promptly supplied to the fuel cell 1 from an initial stage of commencement of the compressor 2, and the fuel cell 1 can rise at an early stage. As this reason, as the power consumption in the start-up battery 18 is lessened, a relatively small and lightweight cell may be used as the start-up battery 18. It is not necessary to use an expensive and heavy secondary cell, and a reduction in cost and a miniaturization of the system can be attained.

[0061]

Further, in starting at the time of the cold state, as the compressed air detours the silencer 10 and the heat exchanger 11 having a large heat capacity for supplying, a temperature of the compressed air to be supplied to the fuel cell 1 quickly increases up to an appropriate temperature, leading to an effect that the efficiency in the electric power generation of the fuel cell 1 can be raised.

[0062]

Incidentally, even if the air flow passage is changed over to the bypass flow passage 7 side and the compressed air is supplied to the fuel cell 1 without passing the silencer 10 and the heat exchanger 11 as described above, as far as doing so at the initial stage of commencement of the fuel cell system (at the stage that the air flow rate Q and the air pressure level P are not over the flow passage change-over flow rate threshold value Q2 and the flow passage change-over pressure threshold value P2), any problem does not occur. That is, at the initial stage of commencement of the fuel cell system, as the engine speed of the compressor 2 is low, the noise caused by the air discharge is low and the silencer 10 is not necessary. Further, as a temperature of the compressed air discharged from the compressor 2 also is low, it is not necessary that the temperature is reduced by the hear exchanger 11.

[0063]

As the engine speed of the motor 15 increases by such the start-up operation, the air flow rate Q and the air pressure level P from the compressor 2 also increase. When the air flow rate Q and the air pressure level P are equal to or more than the power supply change-over flow rate threshold value Q1 and the power supply change-over pressure threshold value P1, the power supply to the motor 15 is changed over to the fuel cell 1.

[0064]

Further, when the engine speed of the motor 15 increases and the air flow rate Q and the air pressure level P are equal to or more than the flow passage change-over flow rate threshold value Q2 and the flow passage change-over pressure threshold value P2, the air flow passage from the compressor 2 is changed over to the main flow passage 6 side. Thus, the control at the time of starting in a supply of the compressed air is terminated,

and the fuel cell system is transferred to the regular operation in the supply of the compressed air.

[0065]

Fig. 3 is a block diagram showing a part of the fuel cell system according to a second embodiment of the present invention.

[0066]

In the second embodiment, in contrast to the first embodiment, the flow rate meter 4 is arranged upstream of the compressor 2 in the first embodiment, while the second embodiment differs from the first embodiment in that the flow rate meter 4 is disposed downstream of the change-over valve 9 and the other arrangement is common. Accordingly, the arrangement common to the first embodiment is shown with the like reference numeral in Fig. 3, and its description is omitted.

[0067]

According to the second embodiment, as the flow rate meter 4 is provided just before the fuel cell 1, a flow rate supplied to the fuel cell 1 can be accurately measured at a position close to the fuel cell 1, resulting in the control with a high precision.

[0068]

Fig. 4 is a block diagram showing a part of the fuel cell system according to a third embodiment of the present invention.

[0069]

According to the third embodiment, the third embodiment differs from the second embodiment in that a filter 21 and a humidity controller (humidity adjuster) 22 are provided between the flow rate meter 4 and the pressure gauge 12, and the other arrangement is common.

[0070]

According to the third embodiment, at the time of starting of the fuel cell system, even when the compressed air passes the bypass flow passage 7 for supplying, a harmful dust in the compressed air can be removed by the filter 21 short of the fuel cell 1. Further, the compressed air can be set to an optimum humidity by the humidity controller 22 for raising the efficiency of the electric power generation of the fuel cell 1.

[0071]

Fig. 5 is a block diagram showing a part of the fuel cell system according to a fourth embodiment of the present invention.

[0072]

According to the fourth embodiment, a temperature sensor 23 is provided between the flow rate meter 4 and the pressure gauge 12, and a temperature of the compressed air is monitored by the temperature sensor 23, and at the point of time when this air temperature T is equal to or more than a flow passage change-over temperature threshold value T2, the air flow passage from the compressor 2 is changed over from the bypass flow passage 7 to the main flow passage 6. As described above, the flow passage is changed over based on the temperature of the compressed air, whereby in particular, the flow passage change-over at the time of the cold state can be performed at

a more appropriate timing, to increase the start-up performance of the fuel cell system. Incidentally, even in the fourth embodiment, as the measurement amount for determining the flow passage change-over timing, the air flow rate Q and the air pressure level P in addition to the air temperature T may occasionally be used by combination.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a block diagram showing a part of a fuel cell system according to a first embodiment of the present invention;

[Fig. 2]

Fig. 2 is a flow chart showing a control at the time of starting in a supply of a compressed air according to the first embodiment;

[Fig. 3]

Fig. 3 is a block diagram showing a part of a fuel cell system according to a second embodiment of the present invention;

[Fig. 4]

Fig. 4 is a block diagram showing a part of a fuel cell system according to a third embodiment of the present invention;

[Fig. 5]

Fig. 5 is a block diagram showing a part of a fuel cell system according to a fourth embodiment of the present invention; and

[Fig. 6]

Fig. 6 is a block diagram showing a conventional fuel cell system.

[Description of the Reference Numerals]

1: fuel cell
2: compressor
4: flow rate meter
6: main flow passage
7: bypass flow passage
8: change-over valve
9: change-over valve
10: silencer
11: heat exchanger
12: pressure gauge
15: motor
17: power supply change-over device
19: start-up battery
20: controller
21: filter
22: humidity controller
23: temperature sensor

[Name of Document] ABSTRACT

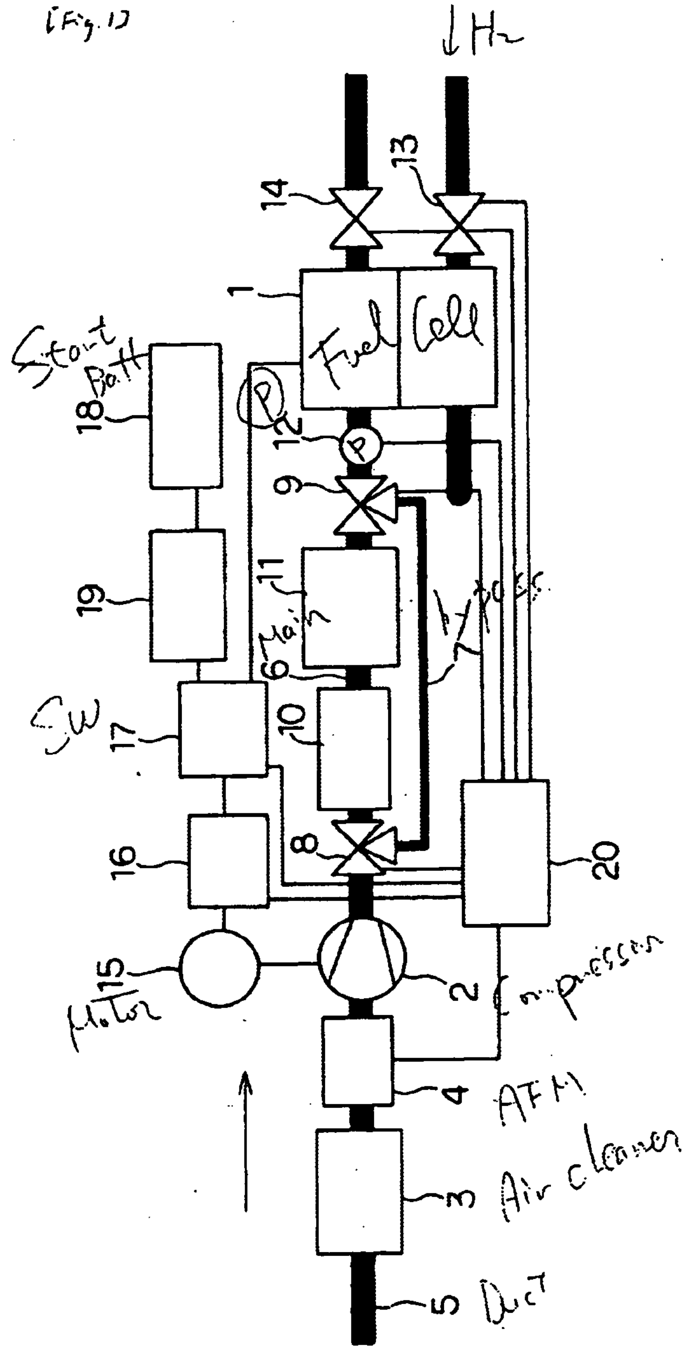
[Abstract]

[Object] To provide a fuel cell system in which an air is promptly supplied to a fuel cell at the time of a start-up operation to expedite a rise of the fuel cell and a start-up battery is made small.

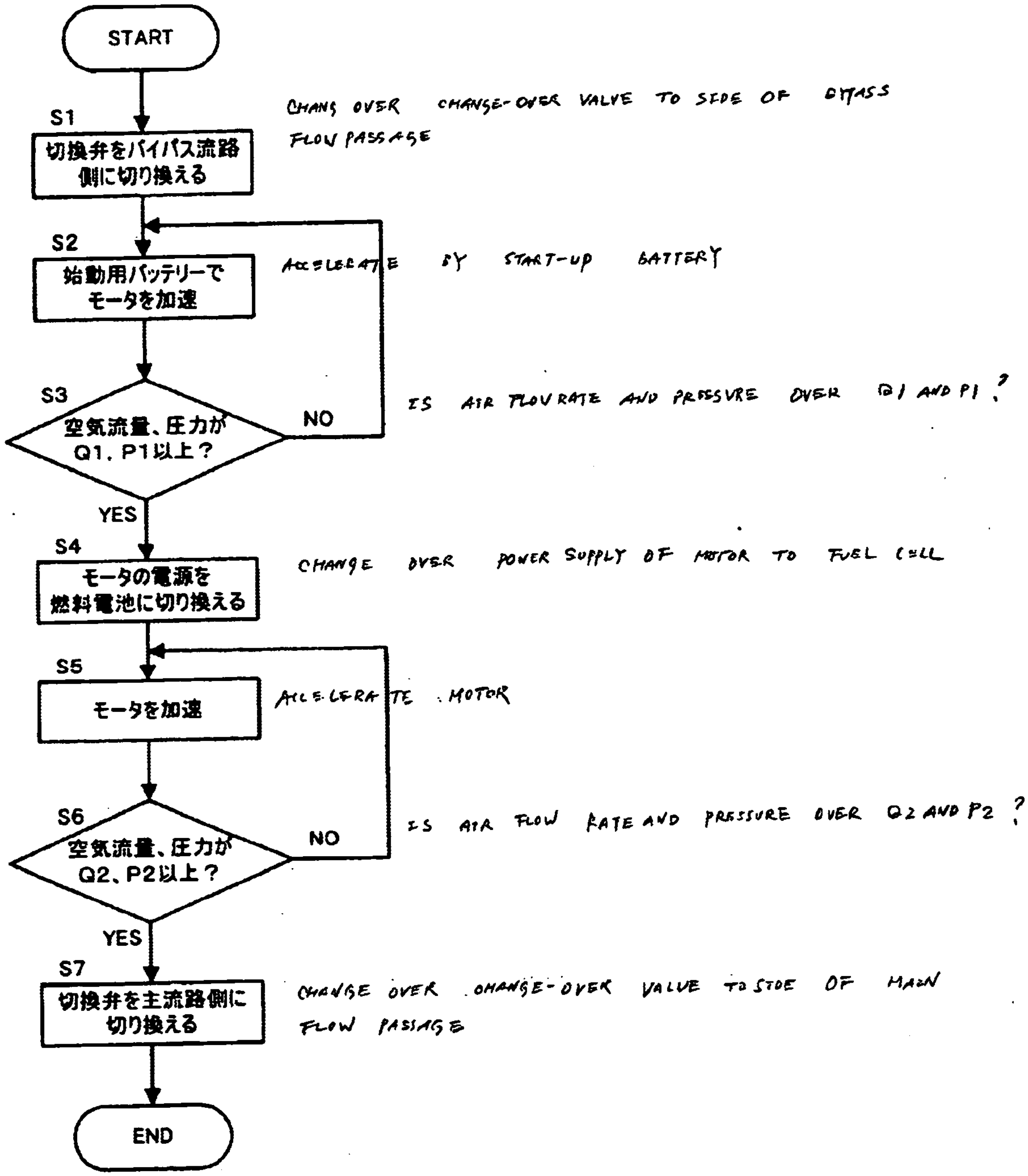
[Solving Means] An air flow passage from a compressor 2 to a fuel cell 1 can selectively be changed over by change-over valves 8 and 9 into a flow passage passing a main flow passage 6 arranged with a silencer 10 and a heat exchanger 11, and a flow passage passing a bypass flow passage 7 having a finer diameter than the main flow passage. After a start-up operation, until a flow rate and a pressure level of a compressed air are raised over a predetermined threshold value, the air passes a side of the bypass flow passage 7 for supplying.

[Selected Figure] Fig. 1

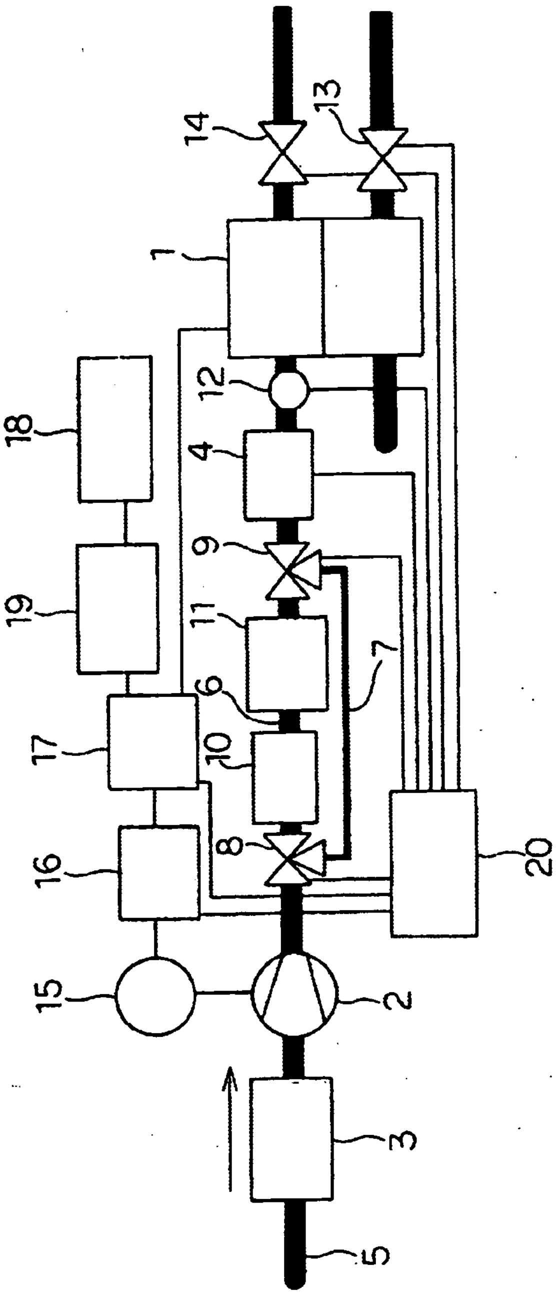
【書類名】　図面
[Name of Document]　DRAWINGS
【図１】
[Fig. 1]



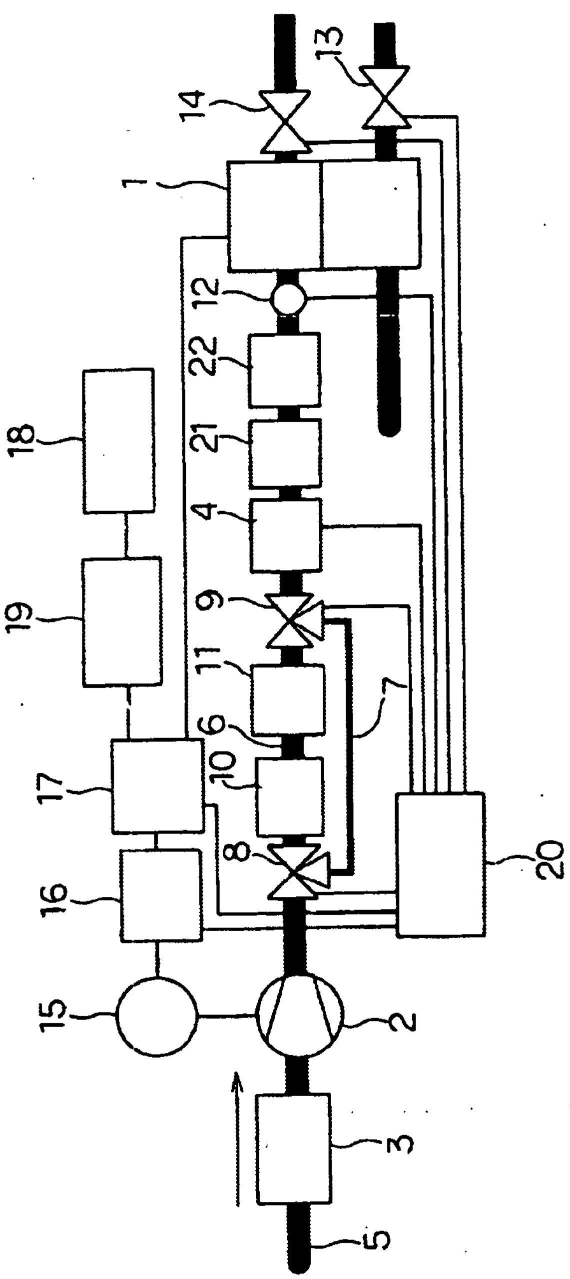
【図２】
[Fig. 2]


START
S1
切換弁をバイパス流路側に切り換える
CHANG OVER CHANGE-OVER VALVE TO SIDE OF BYPASS FLOW PASSAGE
S2
始動用バッテリーでモータを加速
ACCELERATE BY START-UP BATTERY
S3
空気流量、圧力がQ1、P1以上？
NO
IS AIR FLOW RATE AND PRESSURE OVER Q1 AND P1 ?
YES
S4
モータの電源を燃料電池に切り換える
CHANGE OVER POWER SUPPLY OF MOTOR TO FUEL CELL
S5
モータを加速
ACCELERATE MOTOR
S6
空気流量、圧力がQ2、P2以上？
NO
IS AIR FLOW RATE AND PRESSURE OVER Q2 AND P2 ?
YES
S7
切換弁を主流路側に切り換える
CHANGE OVER CHANGE-OVER VALVE TO SIDE OF MAIN FLOW PASSAGE
END

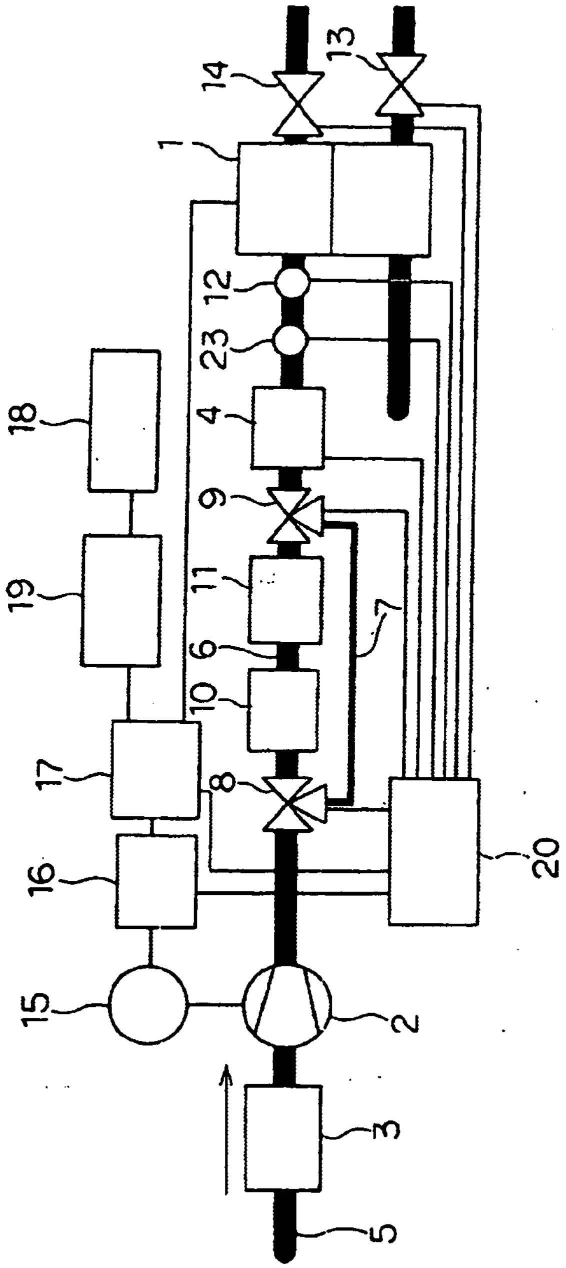
【図３】　[Fig.3]



【図４】　[Fig. 4]



【図５】　[Fig.5]



【図６】　[Fig.6]